

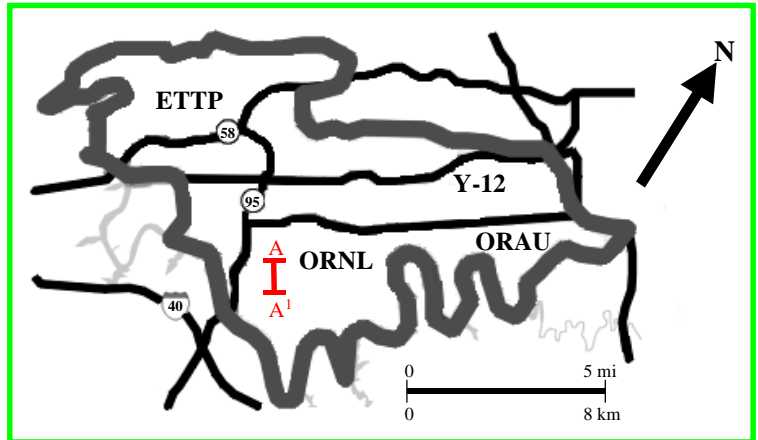
Vadose Zone Fact Sheet Oak Ridge Reservation

Background: The 140 km² (34,516 acre) Oak Ridge Reservation (ORR), located 40 km (25 mi) east of Knoxville, Tennessee, was constructed as part of the secret World War II Manhattan Project. The reservation's current mission is to meet the changing defense, energy, and research needs of the United States.

Issues: During heavy rainfalls, significant volumes of water are transmitted through the vadose zone, resulting in "bathtubbing" (disposal trenches filling with water and overflowing). Fluctuating water tables (up to 5.2 m [17 ft] per year) can also penetrate the base of waste pits and trenches.

Vadose zone infiltration: In undisturbed areas, as much as 90% of the infiltrating precipitation during rainfall events does not reach the water table, but travels through a 1 to 2 m (3 to 6 ft) deep zone to surface water discharge points. Between rainfall events, water movement becomes nearly vertical towards the underlying water table.

Vadose zone characterization/remediation: Records of Decision for the five ORR watersheds are planned to be completed by FY 2001. ORR has divided the reservation, for remediation purposes, into five major watersheds. Interim Actions have also been conducted to excavate contaminated soil, cap landfills, and capture and treat contaminated ground water.



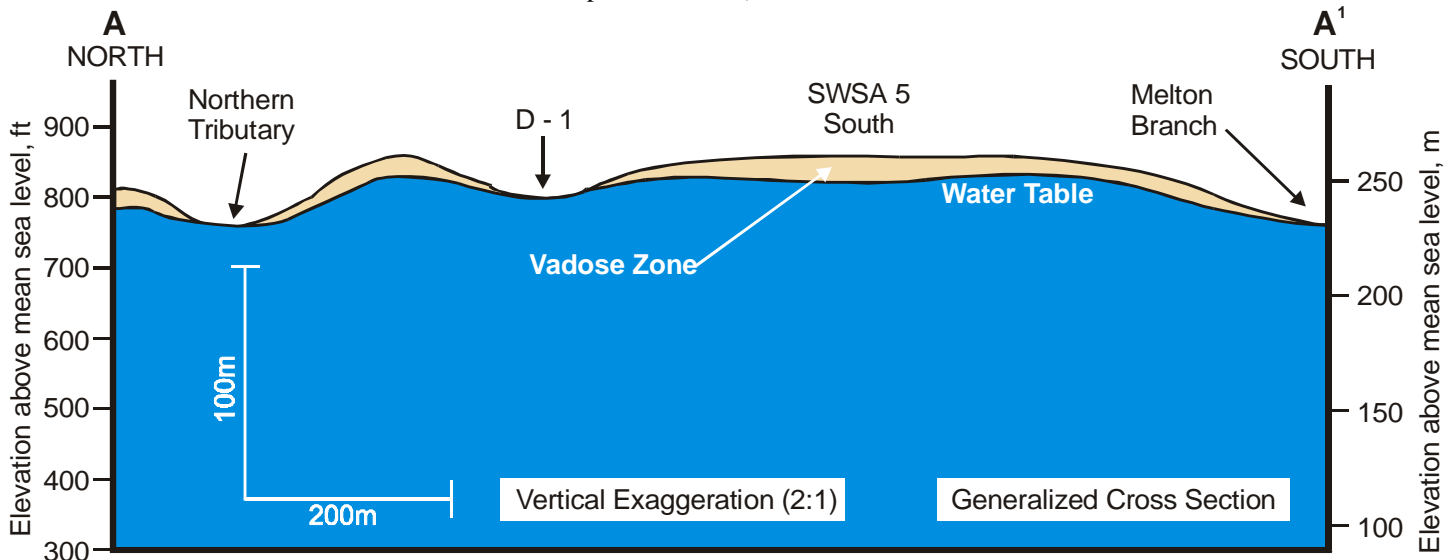
Precipitation: Classified as humid continental, the annual average precipitation is 138.4 cm (54.6 in).

Surface Water: The Clinch River bounds ORR on the south and east. Tributaries on ORR form a weakly developed "trellis" pattern and define the watersheds.

Geology: ORR is situated in a series of southwest-northeast trending valleys and ridges. Elevations range from 226 to 411 m (740 to 1,350 ft) above mean sea level. The major aquifer in the area, the Knox Aquifer, consists of two highly permeable carbonate geologic units. The remaining geologic units are composed mainly of siltstone, shale, sand, and thinly bedded limestone of low to very low permeability.

Vadose Zone Thickness: The vadose zone is thin in the valleys, pinching out against surface water bodies, and 15 to 23 m (50 to 75 ft) thick along the ridge tops or other high topographic areas.

Major contaminants of concern: Tritium, strontium-90, uranium, mercury, nitrate, and volatile organic compounds (primarily carbon tetrachloride, chloroform, trichloroethane, and perchlorethane).



Ground Water Fact Sheet Oak Ridge Reservation

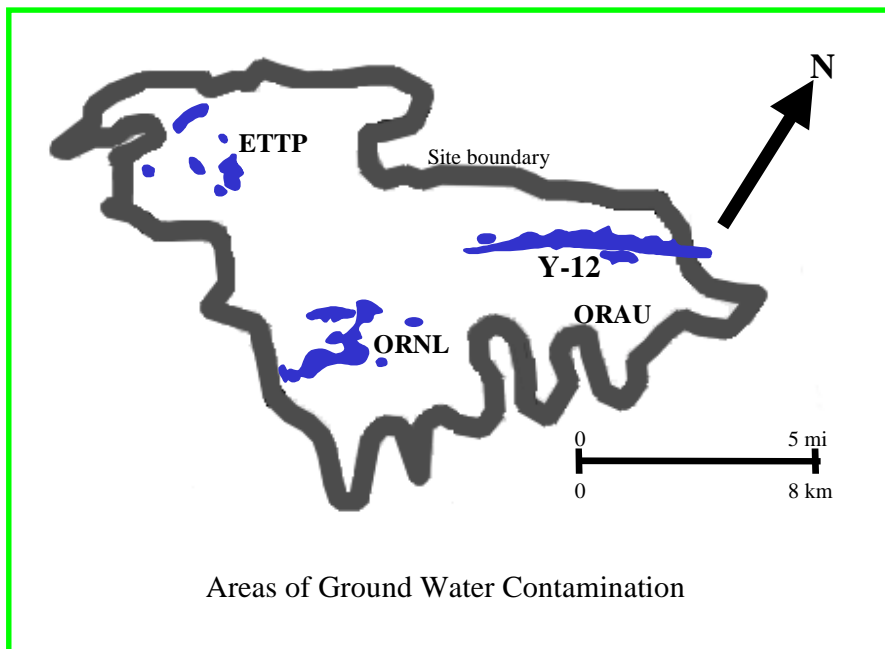
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Hydrogeology: The majority of ground water movement occurs at shallow depths in the upper 15 to 30 m (50 to 100 ft) of the saturated zone. The shallow ground water flow generally follows the contour of the surface topography. In some places, as much as 90% of all water moving through the subsurface occurs above the saturated zone in the storm flow zone – a thin region near the soil surface in which transient precipitation-generated flow provides a major pathway for transporting contaminants near surface sources to streams. Streams and springs are the locations where ground water is discharged to the surface. Ground water velocities range from a few meters per year to 300 m (1000 ft) per year.

Issues: Contaminated ground water has migrated off-site. ORR has negotiated agreements with property owners to notify DOE before using ground water. Constant saturation of buried wastes, disposal of liquid wastes, and secondary sources such as dense non-aqueous phase liquids (DNAPLs) appear to be the principal cause of contaminant releases.

Ground Water Characterization/Remediation: Several Action Memos have been approved outlining ground water remedial actions. Several Removal Actions have also been completed and/or are ongoing. DNAPLs are present and pose a significant problem at ORR. Technologies are needed to prevent further contamination of the ground water. Light non-aqueous phase liquids (LNAPLs) are present in the Y-12 and ORNL areas.

Ground Water Use: Most residents in the Oak Ridge area do not rely on ground water for potable supplies, although suitable water is available. Local ground water provides some domestic, municipal, farm, irrigation, and industrial uses.



Plume Designation	Primary Contaminants	Depth	Remedial Approach
ORNL Central	TCE; Hg; tritium; Sr-90	<30 m (100 ft)	Pump and treat (wells and sumps); lined storm water drains
ORNL East	TCE	unknown	In-situ bioremediation
ORNL West	Tritium; Sr-90	<30 m (100 ft)	Monitored natural attenuation
Melton Valley	TCE; tritium; Sr-90; Pu-238; U-233; Co-60; Tc-99	30 m (100 ft)	Hydraulic isolation
Y-12 Site	TCE; fuels; U; Tc-99; nitrate; PCE; CCL ₄	150 m (500 ft)	Pump and treat; monitored natural attenuation; potential bioremediation

ORNL = Oak Ridge National Laboratory; TCE = trichloroethylene; Hg = mercury; Sr = strontium; Pu = plutonium; U = uranium; Co = cobalt; Tc = technetium; PCE = perchlorethane; CCL₄ = carbon tetrachloride